

Fiasco Bamboo Training Centre

Seminar room and workshop area

Project description

The region of Bono East, but Ghana in general, has a **young population** that, although its vital energy and commitment, struggle to find a **purpose**. Living in rural areas is challenging, due to **limited opportunities** and access to education, and limited labor market. Moreover, **climate change** is exacerbating natural phenomenonns like droughts, short rainy seasons, crop failure, making life still more difficult.

The Fiaso Bamboo Training Centre is a project developed by **Grow Colorful Ghana** for and with the rural community of the Bono East Region, Ghana. Various buildings make up the complex, where experts and members of the community teach **bamboo construction** in public, entertaining, and dynamic learning.

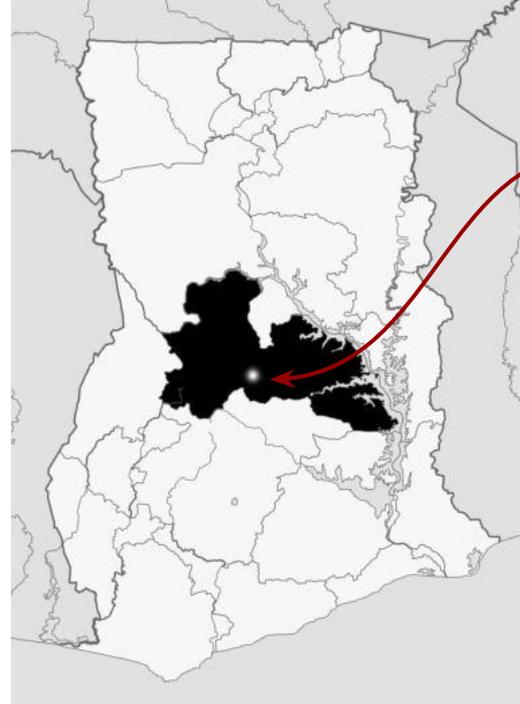
The project intends to promote the usage of **bamboo as a sustainable construction material**, promoting livelihood opportunities for rural youth through bamboo skill development. The center should provide local people with access to technical support, knowledge, and training needed to make good use of their bamboo resources.

The **seminar room** and **workshop area** are vital elements of the center. It is the place where learning, experimentation, tutoring, relations happen strengthening community engagement and public participation.

As the goal is to inspire about bamboo construction, all the buildings shall have some captivating features:

- Beauty
- Sustainability
- Sense of place
- Understandability of the design
- Inspection.

Context: Fiaso, Ghana



FIASO

Living difficult conditions



Poverty



Lack of education



Climate change

Bamboo is “gold”



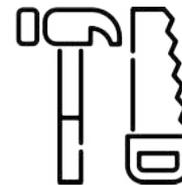
Bamboo thrives in the region



Investment



Training



Practice



**SUSTAINABLE
DEVELOPMENT**

Seminar Room and Workshop

To inspire and teach about bamboo construction, promoting opportunities for the youth rural community

The ingredients



Natural resources



Community engagement



Theory and Practice



Beauty

*A built environment made of bamboo, inspired by Nature,
to showcase the richness of this material*

Sustainability

*Natural materials and optimized forms,
following the principles of biomimicry*

Sense of place

Connection to the culture of the place through materials, patterns, colours, symbols.

Understandability

*The principles that guide the design are
integrated but still comprehensible*

Inspection

*The opportunity to interact with the building
in order to understand how it works*



Online course

Project description

Seminar room



Enclosed
space

Visual
connections

Theory

Weather
protection

Lectures

Flexibility

15-20 occupants

Natural materials

References

Project description

Workshop area



Open space

Direct relation
to Nature

Hands-on learning

Zenith light

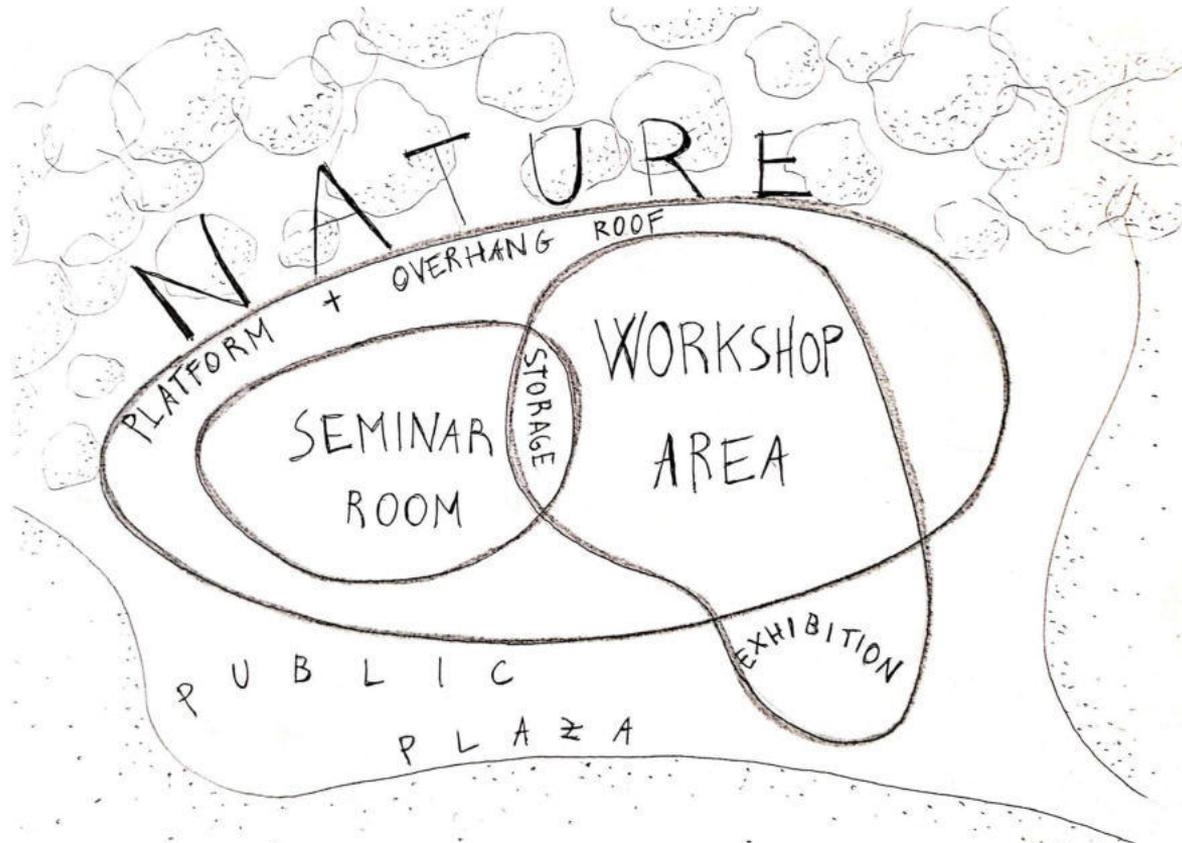
Reciprocal
teaching

Flexibility

Rain and sun
protection

Natural materials

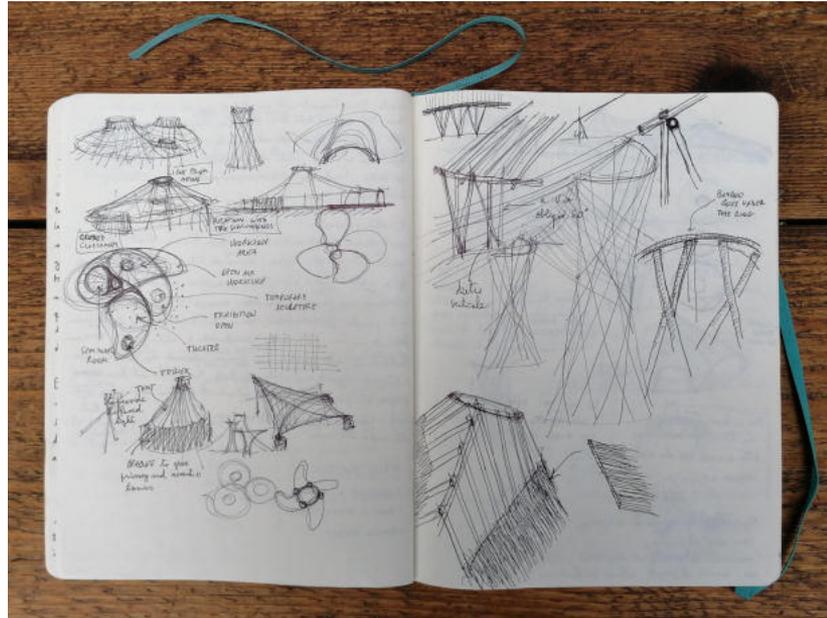
References



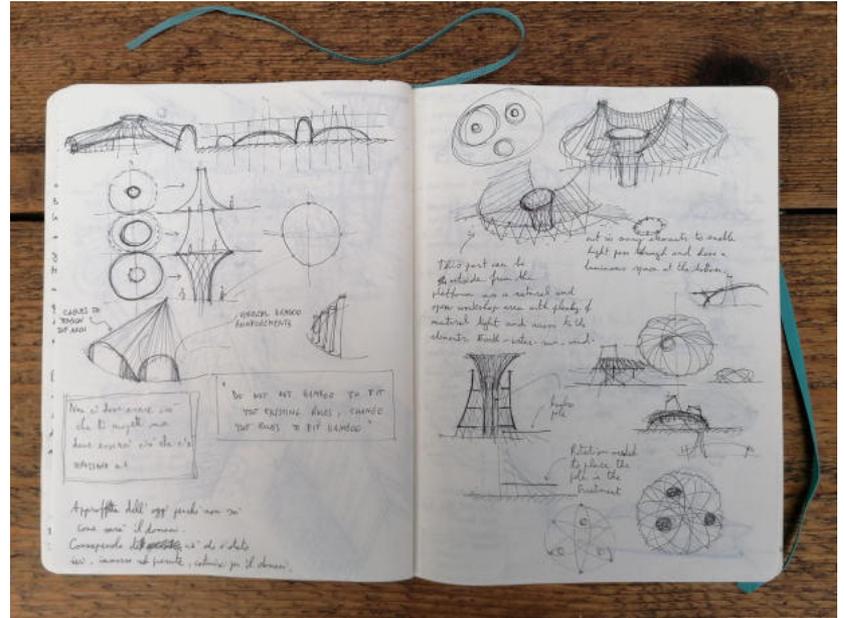
Functional organization chart

Project description

Concept development I



From the sketchbook



From the sketchbook

Concept model I



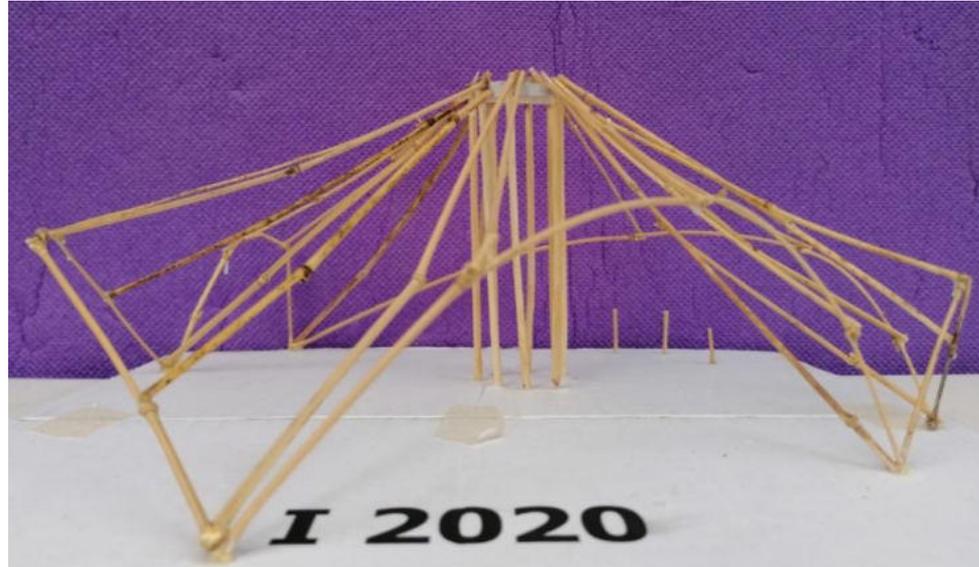
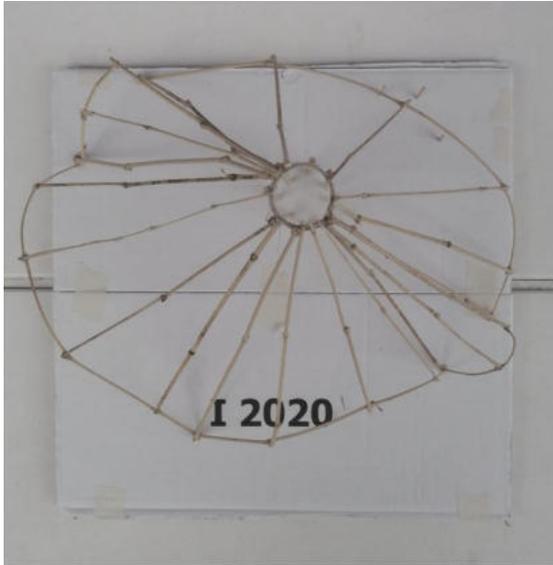
A big **overhang roof** protects the spaces below that receive abundant natural light from the **circular openings**.

Three hyperboloid towers of different heights and diameters support the roof structure. The covered space is freed from the structural grid and **opens to the surrounding Nature**. Different atmospheres merge into a unitary space.



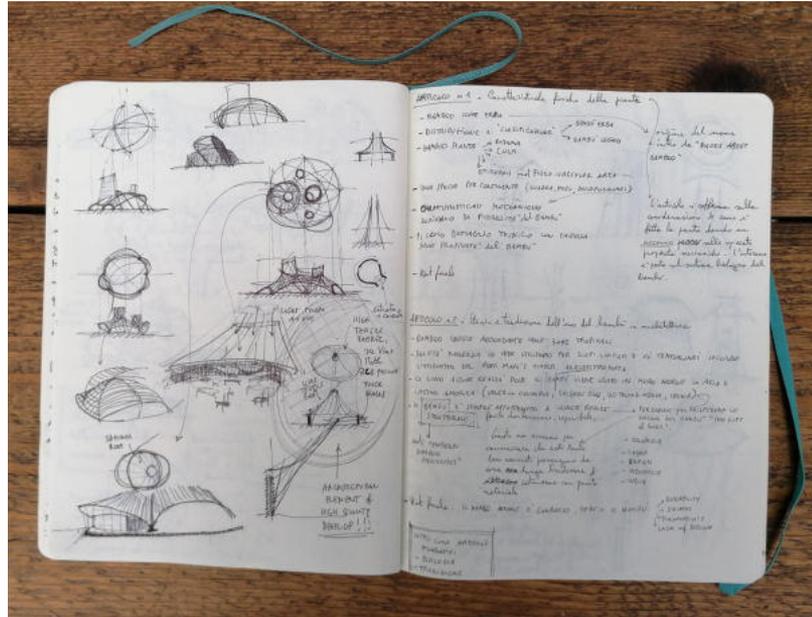
Concept model II

A **central circular void** is the main source of zenithal light. The circular perimeter develops in a **theory of arches**.

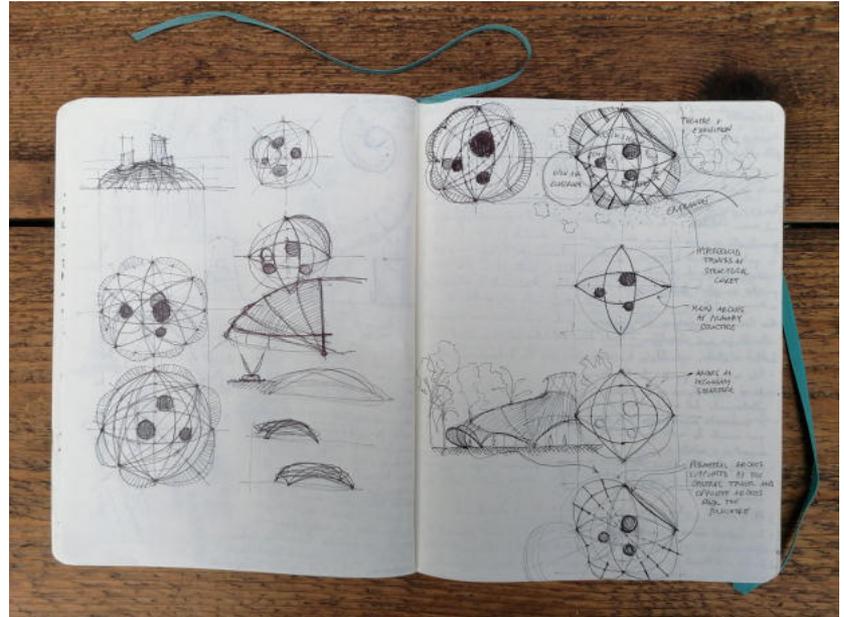


The single hyperboloid tower supports the structure which becomes a roof and structural system. The **arches, inclined towards the exterior**, welcome the visitor and offer covered extra-space close to nature.

Concept development II



From the sketchbook



From the sketchbook

3 facts about bamboo diffusion

Africa/World

Bamboos in Africa are estimated to cover a total of **2.8 million hectares** i.e. about **13% of the total bamboo cover in the world.**

(Lobovikov et al. 2007)

Ghana

Bamboo grows in Ghana on an estimated surface of over **200.000-300.000 hectares** of land.

(S.Tekpetey, Bamboo resources in Ghana, 2011)

State of art

Many factors as the uncertainty associated with taxonomy, lack of investments, cultural bias undermine the research on bamboo in Africa. As a result, the **majority of bamboo species in Africa are not known**, and much of their biology is incompletely understood.

(S.Tekpetey, Bamboo resources in Ghana, 2011)

Species and characterization

Bambusa Vulgaris
Diameter: 4-12 cm
Length: 5 m



Exotic at the beginning, it has become the predominant species covering 90/95% of bamboo resources in Ghana.

(Ebanyenle and Oteng-Amoako, 2007)

Bambusa Arundinacea
Diameter: 15-18 cm
Length: 24-30 m



It is one of the seven most common species of bamboo growing in Ghana.

(UNIDO, 2001)

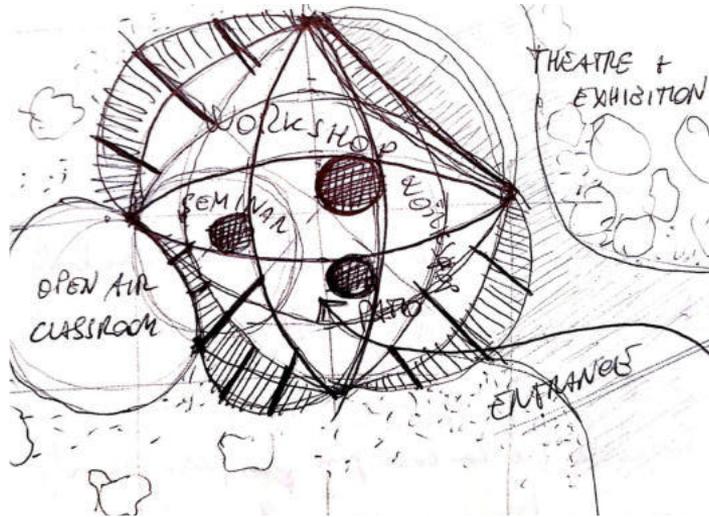
Oxytenanthera Abyssinica
Diameter: 8-10 cm
Length: 10-15 m



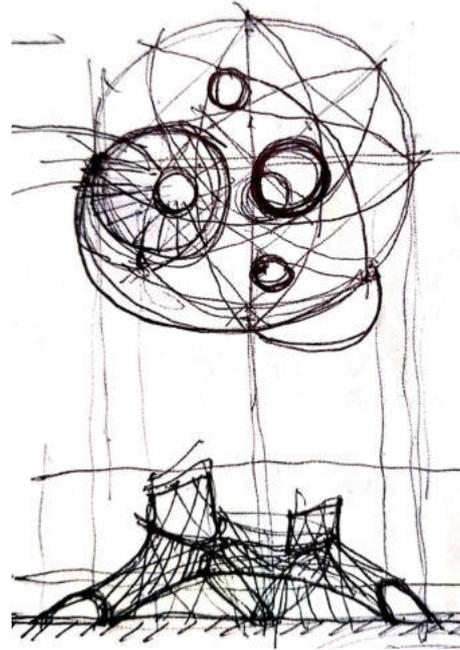
Found mostly in savannah areas of Ghana.

(Abbiw, 1990)

Concept development III



General plan

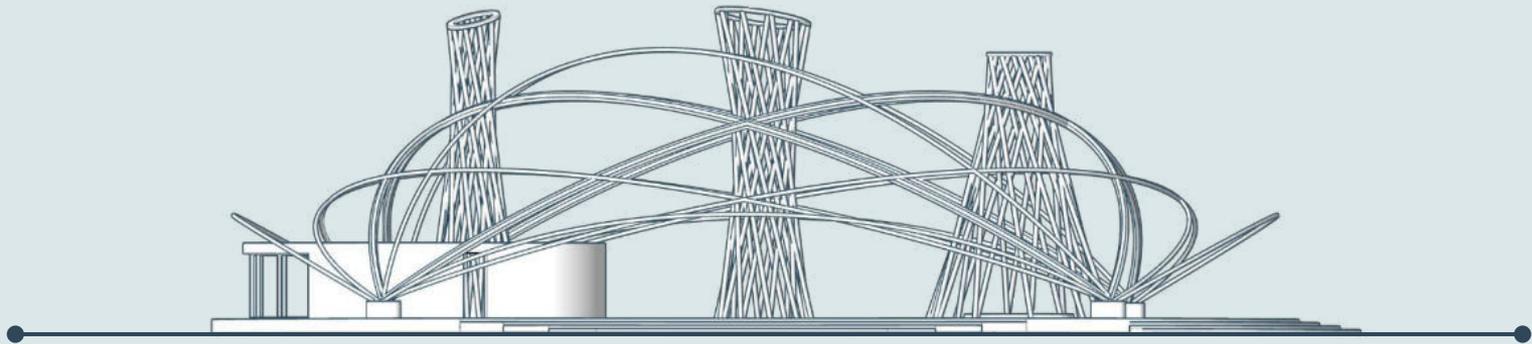


Plan and Elevation

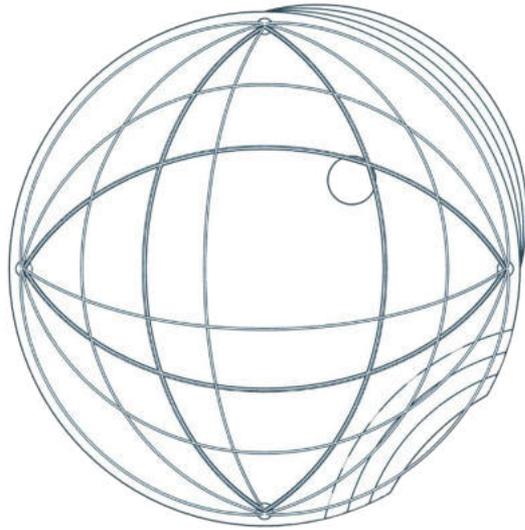
The final concept is not an alternative, but an **integration of the key concepts** of the first two into a more complete object:

From the first study is recovered the **large central space** illuminated from above and covered by a large **vaulted roof** supported by **three hyperboloid towers**

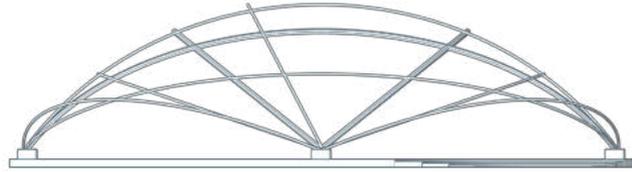
From the second concept, the **theory of perimeter arches** wins, extending the internal space, putting it in communication with the outside, and protecting the bamboo structure.



Structural model - Main structure

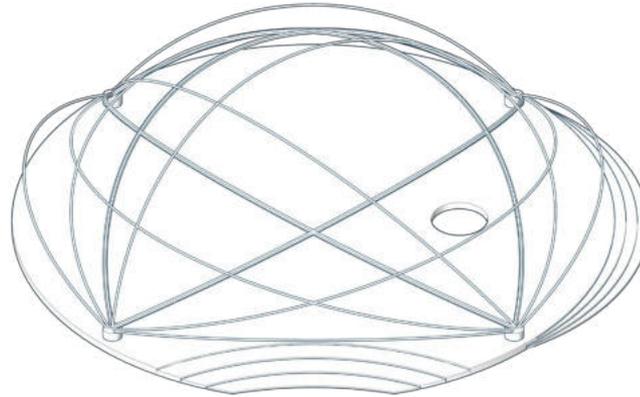


Plan view



Elevation view

Four inclined main arches support the secondary structure of the roof.



Axonometric view

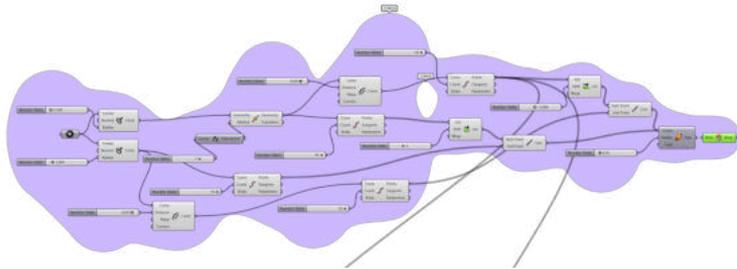
A dome with a height of 7,5 m covers the learning space.

All the arches lean on four solid plinths that define a circle with a diameter of 20m.

Structural model - Hyperboloid towers

Three hyperboloid towers are strategically placed to **stabilize** the main structure span and to make the building more interesting.

During the process of modeling within Grasshopper, a series of **iterations** has been taken into consideration. Solutions B, E, and F have been chosen because of their **heterogeneity** and compliance with the goals of **stability, lighting, coherence with the overall design.**



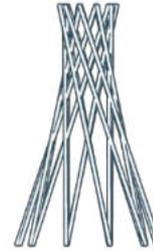
Extract of the Grasshopper script



A



B



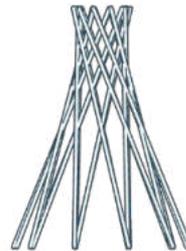
C



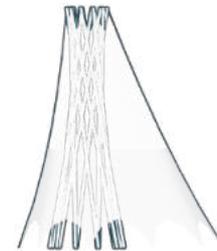
D



E



F

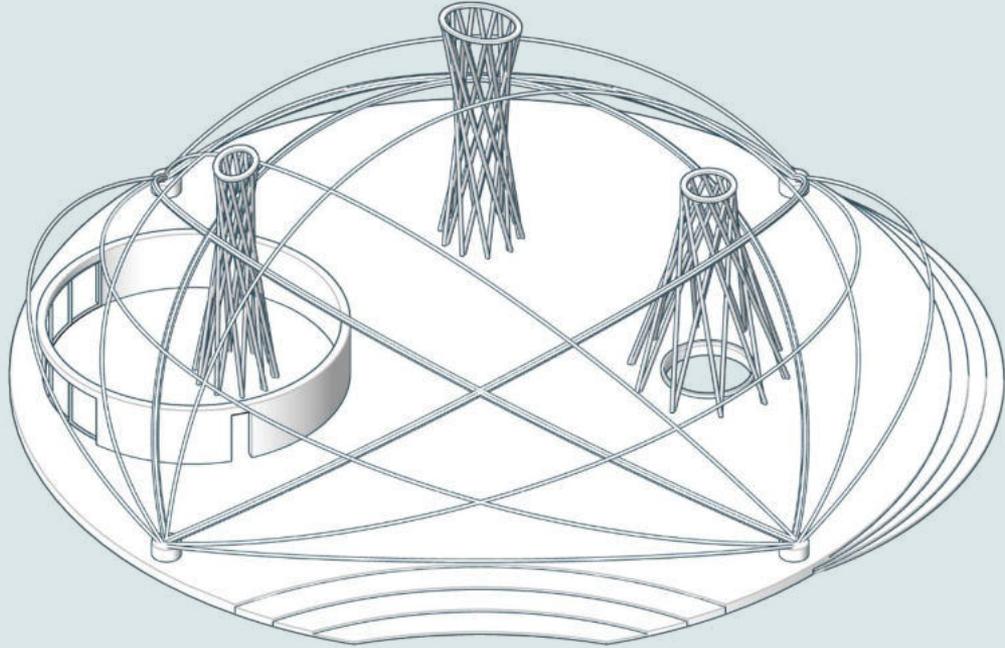


G



H

Parametric iterations of the hyperboloid tower



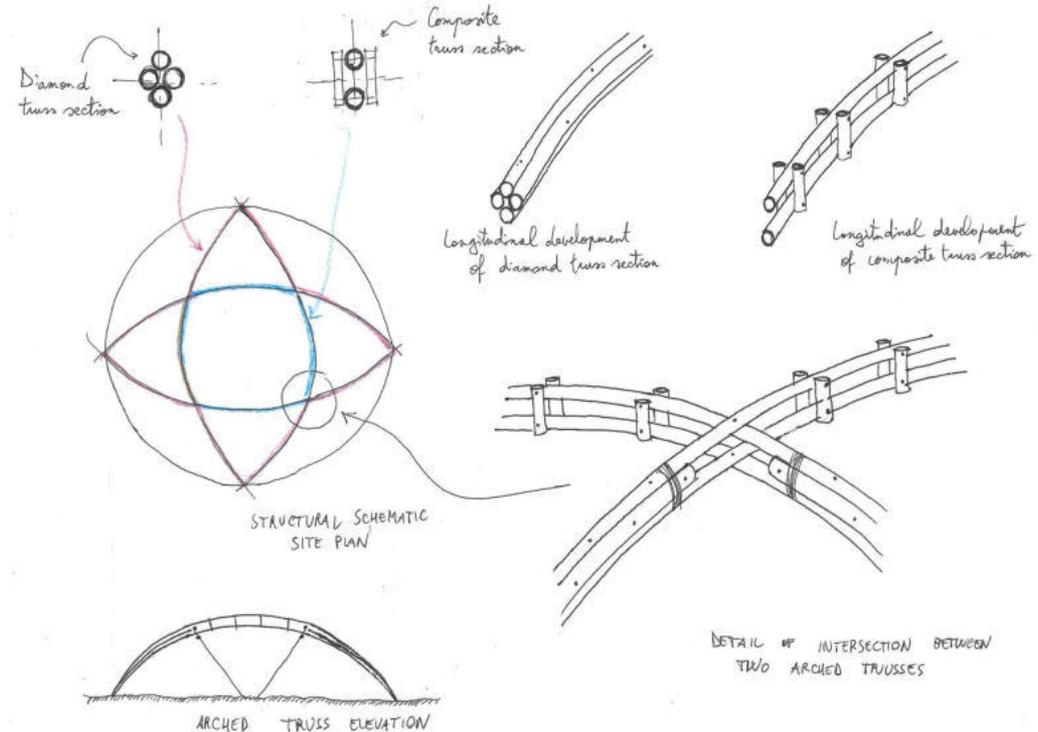
Joinery ideas - Structural optimization

Each arch is built with **two types of sections** to optimize the **weight/strength ratio** and enable the **joinery**.

The **diamond section** is made of 4x15cm diameter culms. It enables to withstand and unload the weights on the plinth foundation.

The **composite section** is made of 2x15cm diameter longitudinal culms and reinforced on the sides with a series of 10cm diameter culm segments.

The **joinery** between the culms is made both by lacing and pinning the adjacent overlapping culms.

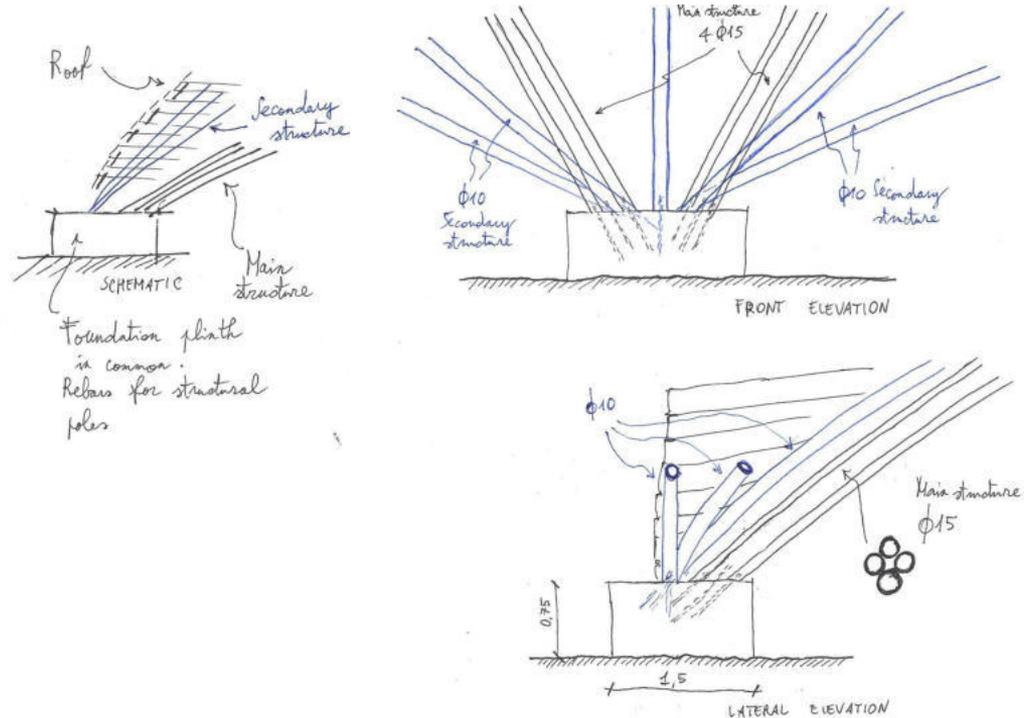


Joinery ideas - Plinth foundation

The circular concrete **plinth** foundation is the **unloading point** for both the main and the secondary structure.

The secondary structure lays externally with respect to the main structure. So, the roof guarantees good **protection from the weather**.

The connections with the plinth are made using **steel rebar** and further **grouting** of the culm end parts.

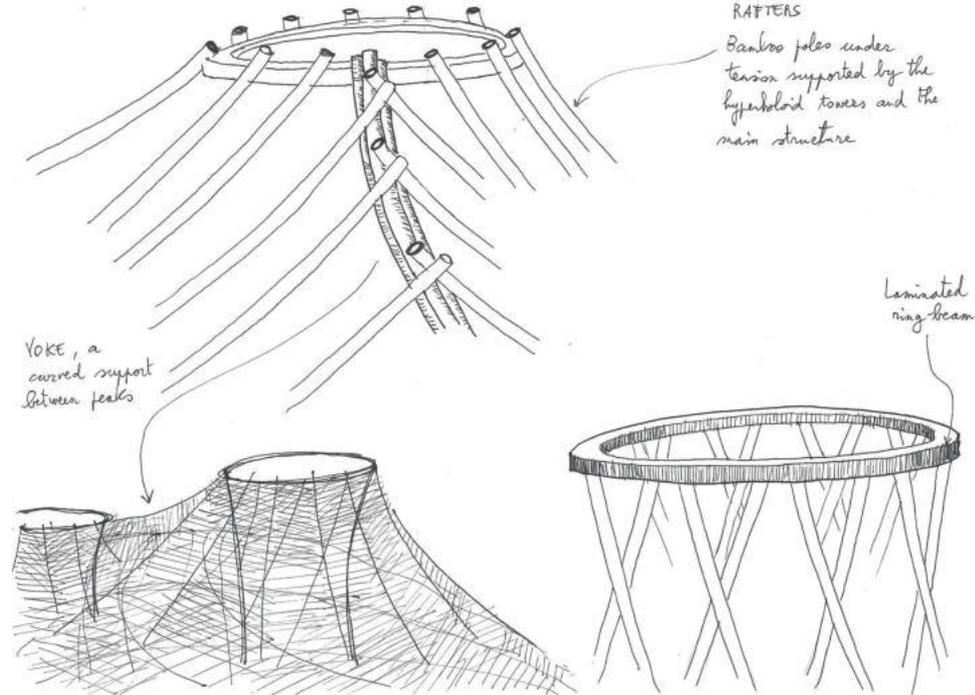


Joinery ideas - Connections between structures

Long **tensioned bamboo poles** connect the hyperboloid towers with the vaulted structural skeleton to define a supporting substructure for the laying of the roofing.

A **laminated ring beam** collects both vertical poles from the tower and inclined rafters from the roof. Furthermore, it hosts the connections for the skylight.

The "**yoke**", a curved element made of different culms joined and treated with the "rup-rup" technique, connects the peaks of the towers and the necessary rafters.



Structural model and joinery ideas

Construction model - Structure



Plan view



Elevation view

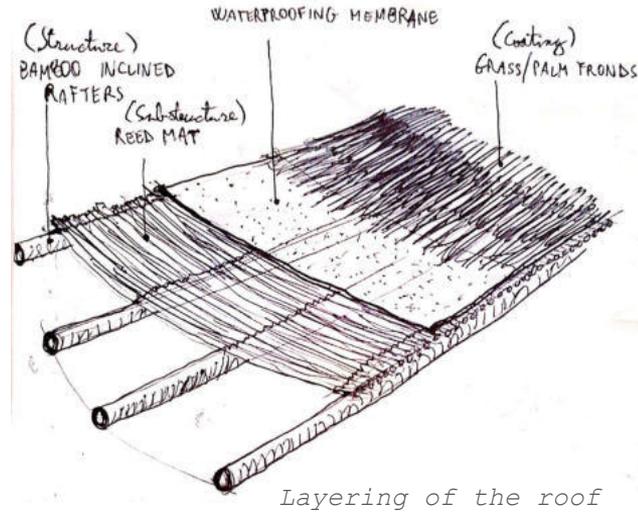


Roof detail

The **sloping roof** turns out to be the most suitable solution also for climate control reasons.

The towers ensure the **hot air rise** and evacuate the building while the rafters enable the roofing laying and a **buffer zone** between the vaulted ceiling and the roof.

The **solar heat gain control** and the **waterproofing** are ensured by the thick natural layers used in the steep roof that could be easily doubled, if necessary.

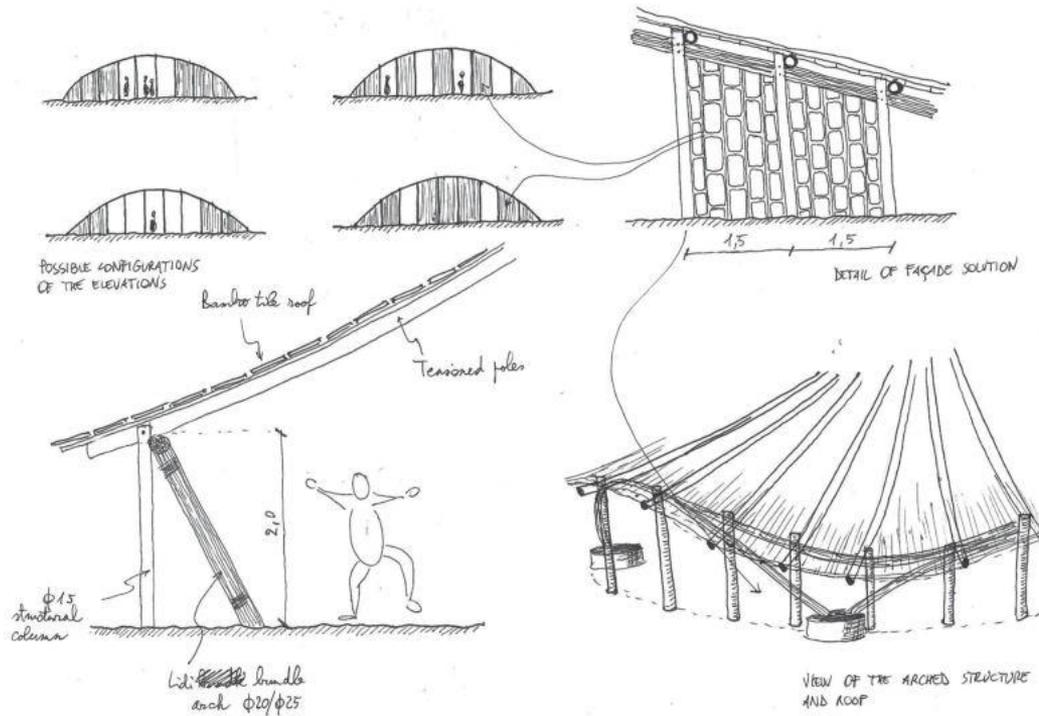


A **reed mat** is placed on the structure to define the surface for the upper layers. A **waterproofing membrane** detaches the mat from the **grass coating** ensuring the waterproofing.



Model details of the roof

Walls - Façade detail



A theory of **lidi bundle arches** defines the undulated profile of the building, supporting the ends of the poles.

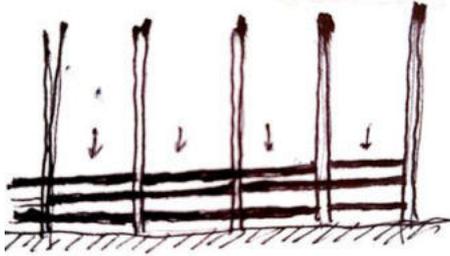
The **façade is rhythmically defined** by a series of 10cm diameter vertical poles with a spacing of 1,5m which support the lidi bundle arches.

The curtain wall solution employs **panels of longitudinal poles sections** with 10/15cm diameter joined together. This enables **permeable skin** and fosters the study of alternative elevation **configurations**.

Walls - Movable partition detail

While the seminar room is well defined from its opaque walls, the open space does not have fixed partitions. A system of **mobile partitions** has been designed to ensure a good level of **flexibility** of the space, without compromising its functionality.

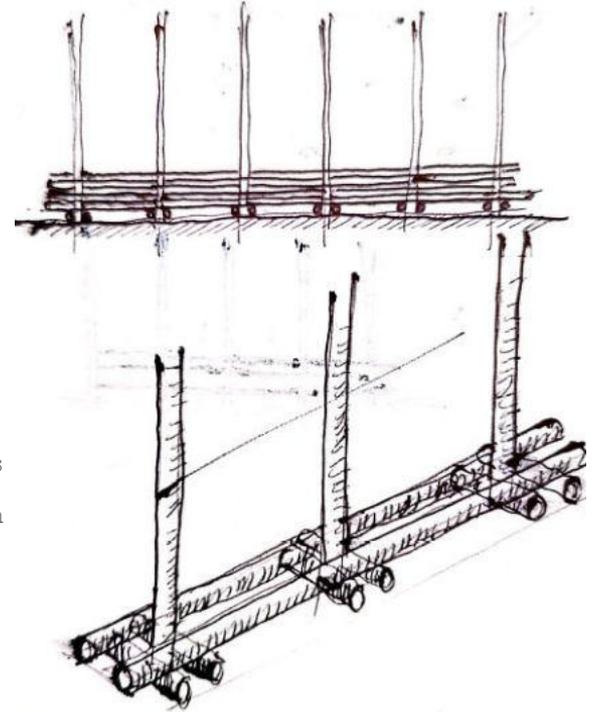
Depending on the needs, it's possible to effortlessly configure more or less **intimate spaces** by simply **moving** lightweight, **self-supporting bamboo partitions**.



*Movable partition
(construction) concept*

The solution is composed of a series of **vertical bamboo posts** with 5cm diameter, connected at the base with 5 cm **horizontal poles**.

The elevation of the panel and its stability are obtained with an **interweaving of bamboo splits** until the final height of the partition.



Detail sketches of the solution

Floor and walls detail

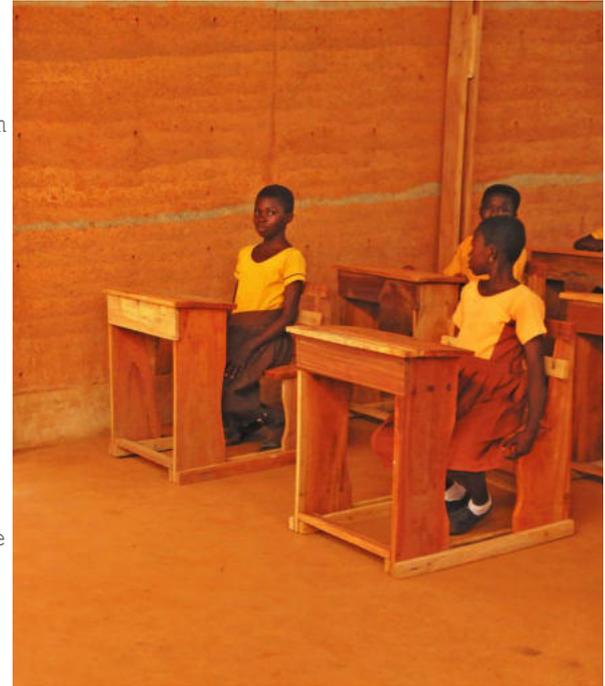


Formwork for the walls construction

Both the floor of the building and the walls of the seminar room are built with **local vernacular techniques**.

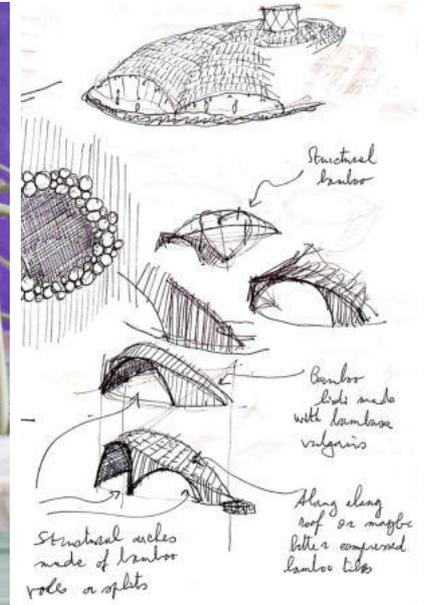
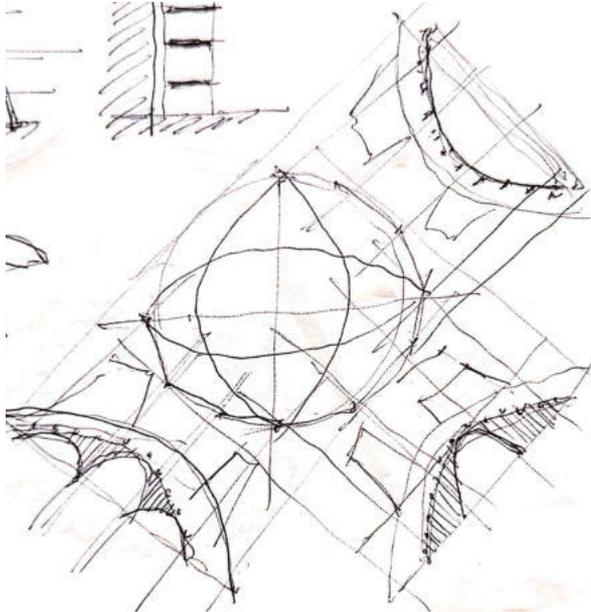
The **floor** is made of **stabilized earth** with the addition of **spots** paved with **bamboo planks** (toilets, exhibition).

The **walls** of the **seminar room**, which require good sound insulation, are realized with the typical **rammed earth technique** (*atakpamè*).



Earth finishes

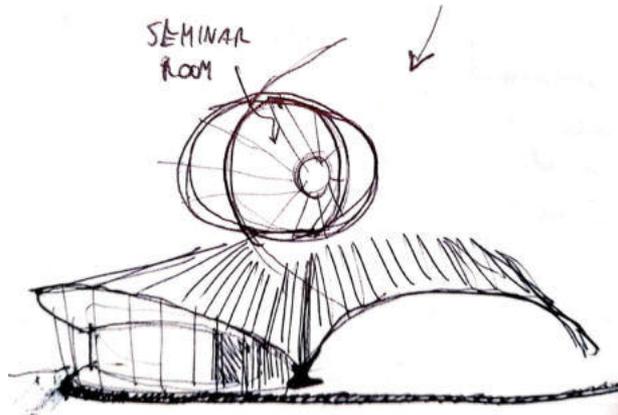
Elevation detail



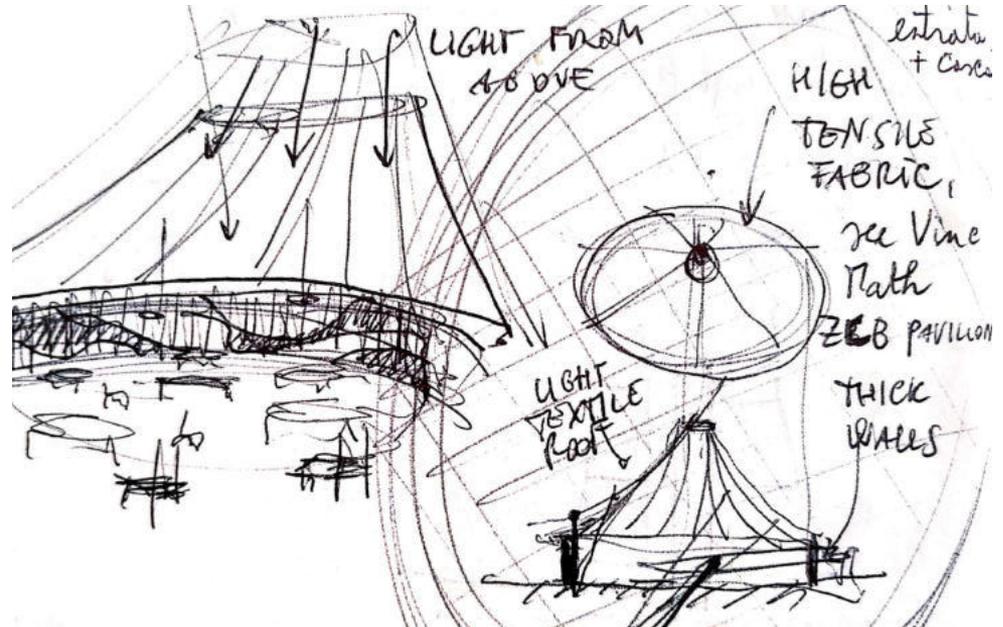
Studies for possible configurations of the elevations

Seminar room development

This learning space is rounded by **earth walls**, naturally illuminated by the **skylight** above, and **opened towards the exterior**. A simple but significant environment to foster tranquil **learning** and contact with the natural elements.



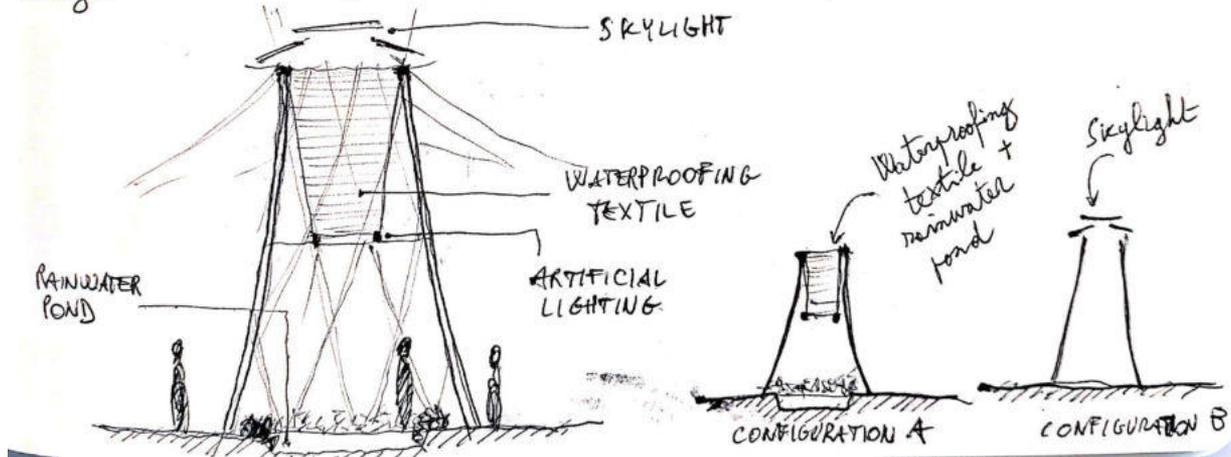
Exterior detail



Interior detail

Internal lighting - Strategy

This drawing features both configuration A and B in the same image



A **lighting strategy** has been developed due to the dimension of the building and the activities that are carried out within it.

Three skylights at the top of the hyperboloid towers help to illuminate the large space below.

Two of them are covered with glass to prevent rain from entering.

One skylight is open and lets both light and rain enter inside, suggesting **direct contact with Nature**.

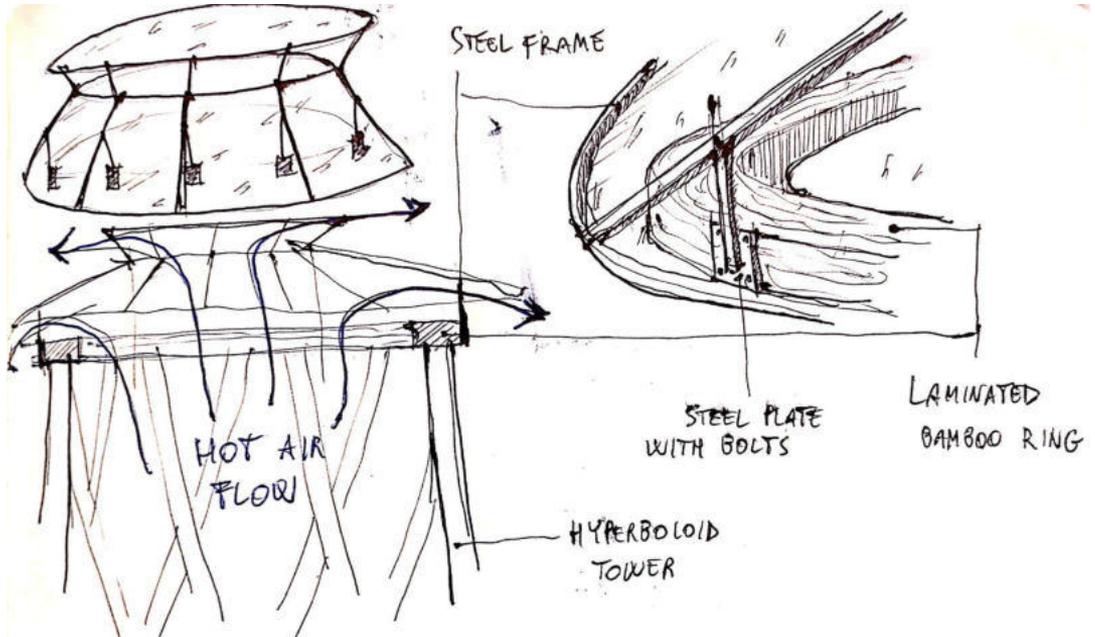
Lighting strategy with the two tower alternatives (right)

Internal lighting - Natural

A **glass and steel crowning** is placed at the top of two towers enabling **light** inside and protecting the bamboo poles with its slight **overhang**.

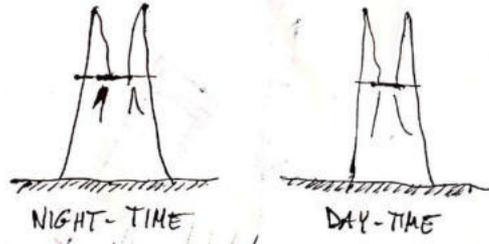
The second purpose is to help mitigate the interior microclimate promoting the **evacuation of warm exhausted air** with the so-called chimney effect.

Pieces of steel welded on-site make up the frame on which the transparent panels (glass, PMMA) are installed. The object is then bolted to the laminated ring with the use of punctual welded plates.

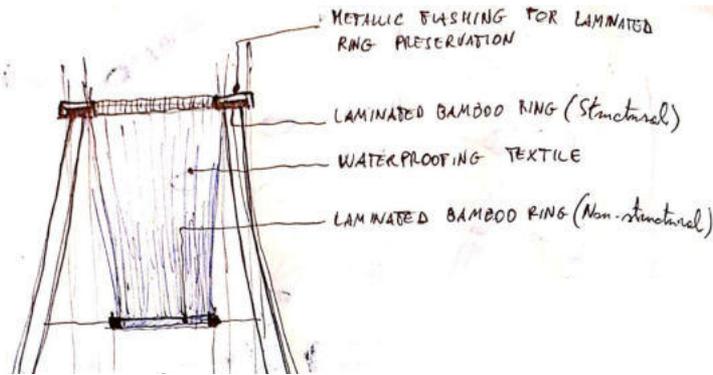


Detail sketches of the skylight and construction

Internal lighting - Artificial



Concept for lighting

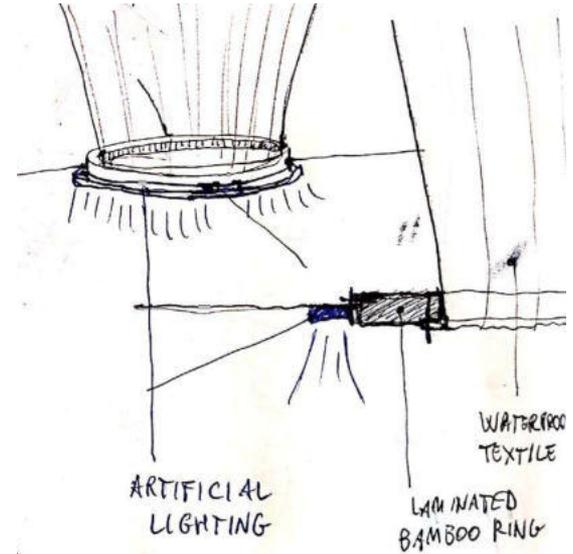


Detail sketch of the conic skylight

The same inverted conical element is a **source of light and mystery**.

During the **day** a **diffused bright light filters** through the white fabric, while during the **night**, **rings of light** are suspended.

The **waterproofing fabric** protects the structure from the weather and helps **collect the water run-offs** in the small pond at the bottom of the tower, where fishes and small vegetation live.



Sketches for artificial lighting and textile installation



Model from above



Plan view with the three roof skylights



Detail of the higher tower with yoke and rafters

“Finished” vs Structural



Side with arched elevations and roof



Roof and elevations structure visible

Bibliography

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